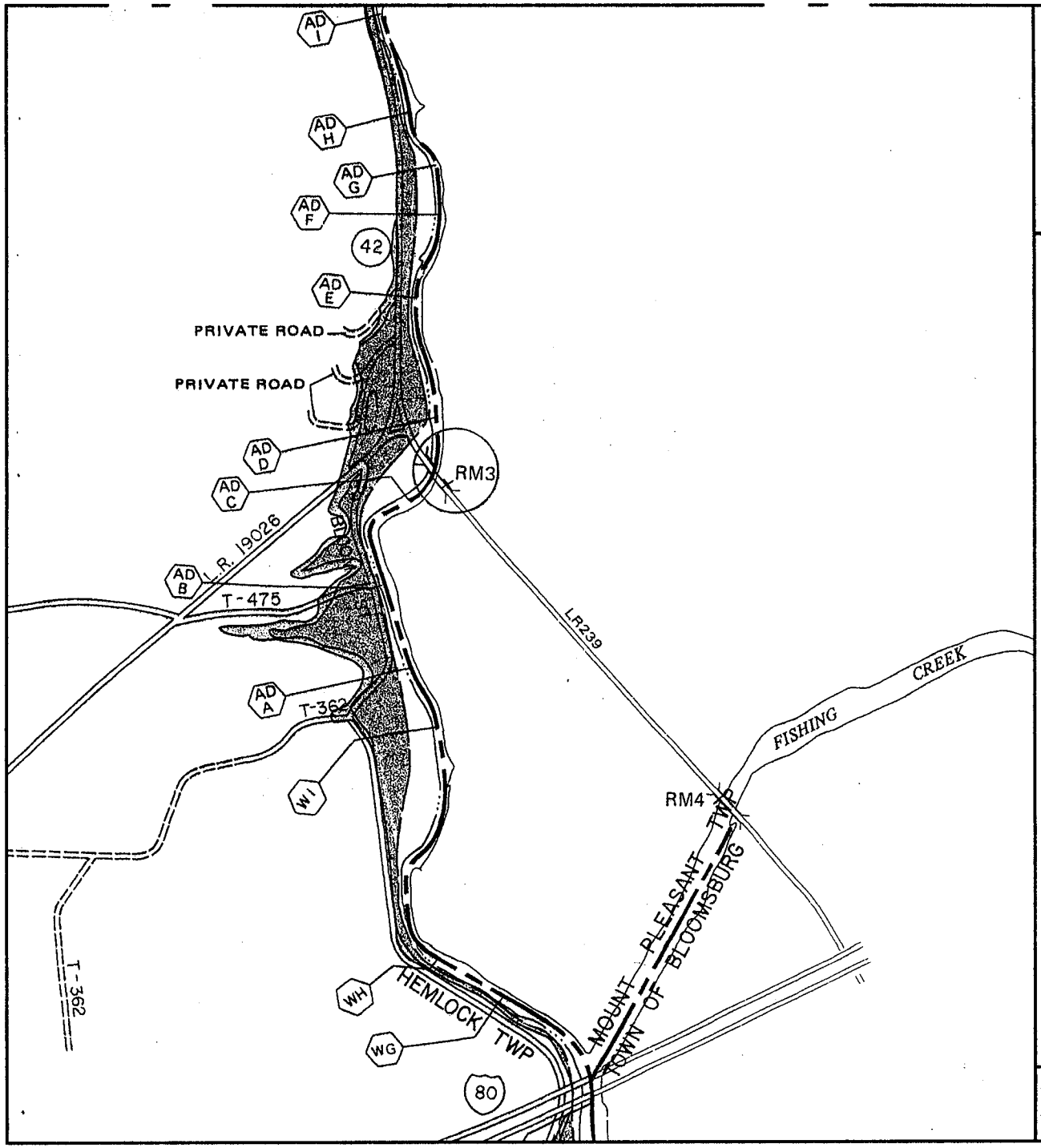
APPENDIX C
FEMA STUDY



APPROXIMATE SCALE

800 0 800 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FLOODWAY

FLOOD BOUNDARY AND FLOODWAY MAP

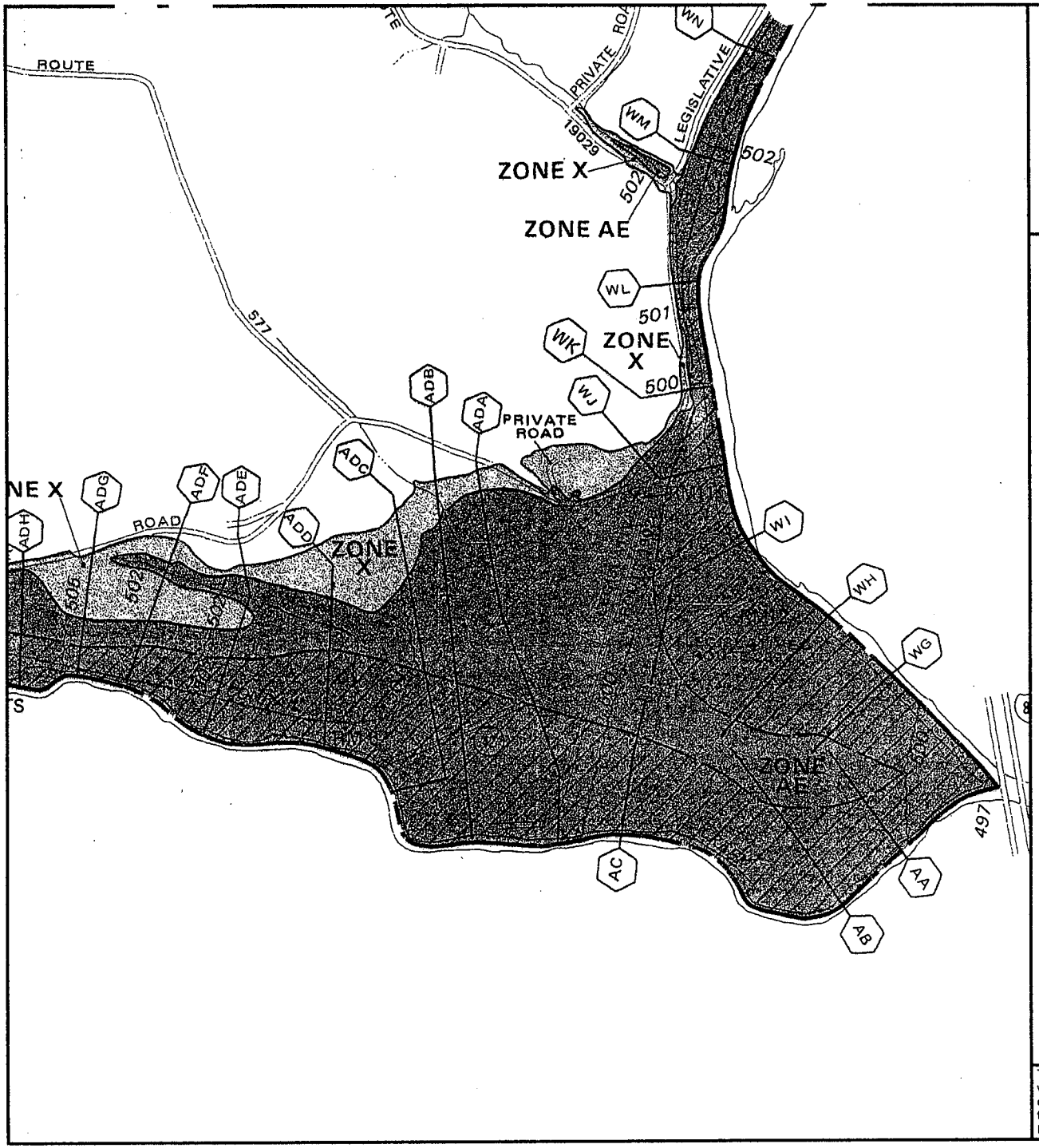
TOWNSHIP OF
HEMLOCK,
PENNSYLVANIA
COLUMBIA COUNTY

PANEL 15 OF 15
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
420344 0015

EFFECTIVE DATE:
AUGUST 1, 1979

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION



APPROXIMATE SCALE

800 0 800 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

TOWNSHIP OF
MOUNT PLEASANT, PENNSYLVANIA
COLUMBIA COUNTY

PANEL 10 OF 10
(SEE MAP INDEX FOR PANELS NOT PRINTED)

PANEL LOCATION

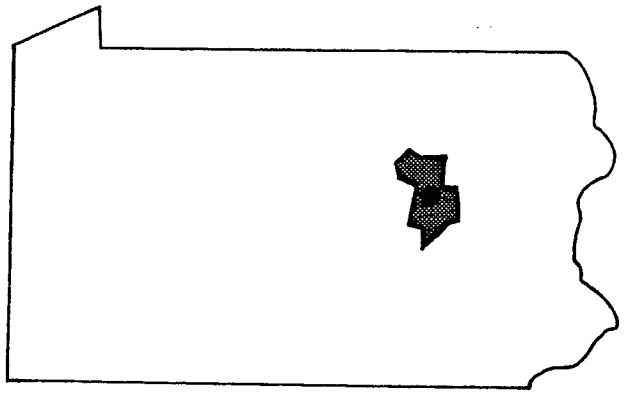
COMMUNITY-PANEL NUMBER
421042 0010 C

MAP REVISED:
APRIL 16, 1990

Federal Emergency Management Agency

FLOOD INSURANCE STUDY

TOWNSHIP OF HEMLOCK, PENNSYLVANIA
COLUMBIA COUNTY



FEBRUARY 1979

U.S. DEPARTMENT of HOUSING & URBAN DEVELOPMENT
FEDERAL INSURANCE ADMINISTRATION

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

FLOOD INSURANCE STUDY
TOWNSHIP OF HEMLOCK, PENNSYLVANIA

1.0 INTRODUCTION

1.1 Purpose of Study

The purpose of this Flood Insurance Study is to investigate the existence and severity of flood hazards in the Township of Hemlock, Columbia County, Pennsylvania, and to aid in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. Initial use of this information will be to convert Hemlock to the regular program of flood insurance by the Federal Insurance Administration (FIA). Further use of the information will be made by local and regional planners in their efforts to promote sound land use and flood plain development.

1.2 Coordination

The Columbia County Planning Commission and the Susquehanna Economic Development Agency were contacted for information on the history of local flooding problems. The Pennsylvania Department of Community Affairs was given notice of the study and invited to attend the consultation and coordination sessions which were held with local officials.

An initial Consultation and Coordination Officer's (CCO) meeting was held with township officials on June 16, 1975, to explain the Flood Insurance Study procedures and to obtain from these officials any community flood information they could provide. A final CCO meeting was convened with township officials on August 30, 1978 to present the results of this study.

Flood discharge information was coordinated with the Baltimore District of the U. S. Army Corps of Engineers (COE) and the Harrisburg District Office of the U. S. Geological Survey (USGS).

1.3 Authority and Acknowledgements

The source of authority for this Flood Insurance Study is the National Flood Insurance Act of 1968, as amended.

The hydrologic and hydraulic analyses for this study were prepared by the Susquehanna River Basin Commission for the Federal Insurance Administration, under Contract No. H-3824. Compilation or computation of work maps, water-surface profiles, floodways and flood

boundary delineations were performed by Michael Baker, Jr., Inc., under subcontract to the Susquehanna River Basin Commission. This work, which was completed in February 1978, covered all significant flooding sources in the Township of Hemlock.

2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the Township of Hemlock, Columbia County, Pennsylvania. The area of study is shown on the Vicinity Map (Figure 1).

The areas studied by detailed methods were selected with priority given to all known flood hazard areas, areas of projected development, and areas of proposed construction for the next five years, through February 1983. Fishing Creek, Little Fishing Creek, and part of Hemlock Creek extending from its mouth to approximately 1,000 feet upstream of Interstate Route 80 were studied by detailed methods.

Approximate methods of analysis were used to study those areas having low development potential and/or minimal flood hazards as identified at the initiation of the study. The scope and methods of study were proposed to and agreed upon by the FIA.

Two-thirds of Hemlock Creek upstream of Interstate Route 80, West Hemlock Creek, and Frozen Run were studied by approximate methods.

2.2 Community Description

The Township of Hemlock is located in west-central Columbia County, in central Pennsylvania, immediately northwest of the Town of Bloomsburg, the county seat. The Township of Hemlock abuts the Township of Mount Pleasant to the east, the Town of Bloomsburg to the southeast, and the Township of Montour to the south. The 1970 population of the township was 1,506, a 15.8 percent increase since 1960. A total area of 17.1 square miles is included within the township.

Hemlock lies within the Appalachian Ridge and Valley Province of Pennsylvania. No major mountain ridges pass through the township. The topography consists mainly of several very high hills rolling

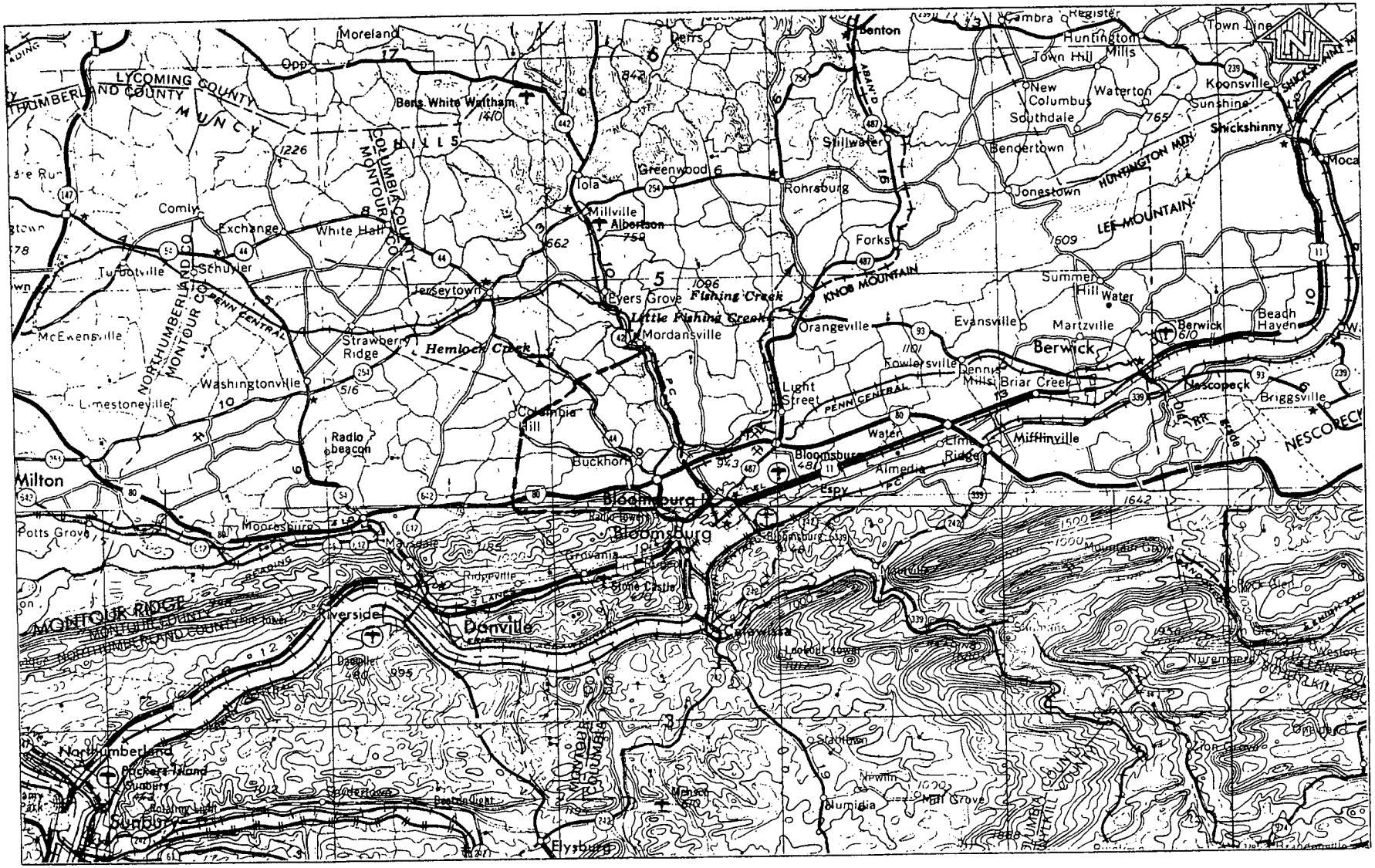


FIGURE 1

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

APPROXIMATE SCALE

4 0 4 8 12 MILES

VICINITY MAP

agricultural valleys. Tracts of gently sloping terrace land and level flood plain can also be found along the major streams.

Climate in the area is continental, but it is modified by the effects of the Atlantic Ocean and the Gulf of Mexico. The mean annual temperature ranges in the low 50s (degrees Fahrenheit). Annual precipitation averages about 37 to 40 inches and is well distributed throughout the year. Slightly over half of the annual precipitation falls between the months of April and September. During the summer months, the area is regularly subjected to afternoon and evening thunderstorms often accompanied by heavy rains and damaging winds. Hurricanes originating in the tropics occasionally pass through the vicinity bringing prolonged periods of heavy rainfall.

Fishing Creek and Little Fishing Creek, the two most prominent drainage features, form the entire eastern boundary of the township. Other secondary streams include Hemlock Creek, West Hemlock Creek, and Frozen Run. Flood hazard areas along these streams are largely undeveloped. However, there are significant centers of development along Fishing Creek.

2.3 Principal Flood Problems

Fishing Creek, and its tributary streams, are the chief sources of flooding in the township. Record flooding occurred on Fishing Creek in June 1972 during Tropical Storm Agnes when a peak flow of 30,900 cubic feet per second (cfs) was measured at the stream gage near the Town of Bloomsburg (Reference 1). As a result of Tropical Storm Agnes, 12 1/2 inches of rainfall created severe runoff conditions and caused high flows on all local streams and tributaries to Fishing Creek (Reference 2).

The small community of Fernville, located just across Fishing Creek from the Town of Bloomsburg received its greatest flood damage during the 1972 Agnes storm. Many homes were flooded up to the first floor level. Several nearby trailers were washed away. Summer homes and trailers on Little Fishing Creek were also damaged by floodwaters. Elsewhere in the township, overflowing tributary streams flooded basements and eroded large amounts of topsoil from yards and lots.

Farmers in the vicinity reported heavy crop loss and soil erosion damage. About $76,000 was expended by the Township of Hemlock to repair washed-out sections of road and clear streams of silt and other debris.

Tropical Storm Eloise of September 1975, caused similar damages in Fernville. Though troublesome, flooding due to Eloise was of less intensity than that of the 1972 storm in the Township of Hemlock.

2.4 Flood Protection Measures

There are no local or regional flood protection projects either in existence or proposed in the township.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Floods having recurrence intervals of 10, 50, 100, and 500 years have been selected as having special significance for flood plain management and for flood insurance premium rates. The analyses reported here reflect current conditions in the watersheds of the flooding sources.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for floods of the selected recurrence intervals for each flooding source studied in detail in the township.

For the purposes of this study, the log-Pearson Type III method recommended by the Water Resources Council was used to determine discharge relationships (Reference 3). For gaged sites, the flood frequency data were obtained directly from statistical analyses of flood peak discharge data. For ungaged sites, it was necessary to regionalize the flood-frequency data for two or more sites.

For Fishing Creek, a statistical analysis of peak-discharge records was made for the stream gage located 6.2 miles upstream from the eastern boundary of the Township of Hemlock (Reference 2). This gage has 37 years of record. The analysis followed the log-Pearson method (Reference 3). The mean, M, and the standard deviation, S, obtained from the gage analysis were used to calculate coefficients C_m and C_s in the following equations:

$$M = C_m + 0.75 \log (A)$$

$$S = C_s - 0.05 \log (A)$$

where A is the drainage area in square miles (Reference 2). The discharges for Hemlock were determined using these coefficients and the appropriate drainage area.

A stream gage was in operation on Little Fishing Creek during the period 1941-58. This gage record was not deemed sufficiently representative of flooding characteristics of the creek and as a result it was not used. The discharges for Little Fishing Creek and Hemlock Creek, which are ungaged streams, were determined using coefficients for Fishing Creek, since both streams are tributaries to Fishing Creek and they both have similar drainage areas.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
FISHING CREEK					
At mouth of Hemlock Creek	385	24,300	45,700	58,500	102,000
HEMLOCK CREEK					
At mouth	16.5	2,880	6,250	8,500	17,200
LITTLE FISHING CREEK					
At mouth	68.1	7,500	15,000	19,900	38,500

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of the flooding sources studied in detail in the township were carried out to provide estimates of the elevations of floods of the selected recurrence intervals along each of these flooding sources.

Water-surface profiles for the 10-, 50-, 100-, and 500-year floods were calculated using the COE's HEC-2 step-backwater computer program (Reference 4). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals.

Cross sections were located at regular intervals along the stream length and at significant changes in ground relief, land use and

land cover. Ground elevations for the cross sections were photogrammetrically obtained as the 1"=200' scale base maps were compiled (Reference 5). The channel bottom elevations were taken from field-surveyed cross sections at an interval distance of not more than 1,000 feet. Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway is computed (Section 4.2), selected cross-section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 3). Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals.

Reach lengths for the stream channels were measured along the centerline of the channel and between cross sections, as scaled from the 1"=200' maps (Reference 5). The overbank reach lengths were measured along the approximate centerline of the effective out-of-channel area as scaled from the 1"=200' maps (Reference 5).

Roughness coefficients (Manning's "n") were evaluated from aerial and ground level photographs, topographic maps, and on-site field examinations (Reference 5). The "n" values were selected from tables based on channel conditions, overbank vegetation, and land use (Reference 6).

Backwater elevations for Fishing Creek were started at the creek mouth using normal depth calculations developed by the SRBC. For Fishing Creek, channel roughness values ranged between 0.035 and 0.039, and overbank values ranged between 0.045 and 0.090.

Backwater elevations for Hemlock Creek were started at its mouth using critical depth calculations developed by the SRBC. For Hemlock Creek, channel roughness values ranged between 0.040 and 0.055, and overbank values ranged between 0.055 and 0.100.

Backwater elevations for Little Fishing Creek were started at its mouth using coincident conditions computed with Fishing Creek as both streams have similar drainage areas. For Little Fishing Creek, channel roughness values ranged between 0.042 and 0.056, and overbank values ranged between 0.045 and 0.100.

The approximate elevations of 100-year flooding for the upstream reach of Hemlock Creek, West Hemlock Creek, and Frozen Run were developed from slope-area calculations using Manning's equation, with cross sections taken from available mapping (Reference 5).

All elevations used in this study are referenced to National Geodetic Vertical Datum of 1929 (NGVD) formerly referred to as Sea Level Datum of 1929. Locations of the elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study are based on the effects of unobstructed flow. The flood elevations shown on the profiles are valid only if the hydraulic structures remain unobstructed and flood control structures operate properly and do not fail.

4.0 FLOOD PLAIN MANAGEMENT APPLICATIONS

A prime purpose of the National Flood Insurance Program is to encourage state and local governments to adopt sound flood plain management programs. Each Flood Insurance Study, therefore, includes a flood boundary map designed to assist communities in developing sound flood plain management measures.

4.1 Flood Boundaries

In order to provide a national standard without regional discrimination, the 100-year flood has been adopted by the FIA as the base flood for purposes of flood plain management measures. The 500-year flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the boundaries of the 100- and 500-year floods have been delineated using the flood elevations determined at each cross section; between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2,400 with a contour interval of 5 feet (Reference 5). In cases where the 100- and 500-year flood boundaries are close together, only the 100-year boundary has been shown.

The methodology for the delienation of approximate flood boundaries is described in Section 3.2

The boundaries of the 100- and 500-year floods are shown on the Flood Boundary and Floodway Map (Exhibit 3). Small areas within the flood boundaries may lie above the flood elevations and, therefore, may not be subject to flooding. Due to limitations of the map scale or lack of detailed topographic information, such areas are not shown.

4.2 Floodways

Encroachment on flood plains, such as artificial fill, reduces the flood-carrying capacity, increases the flood heights of streams,

and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the Flood Insurance Program, the concept of a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent flood plain areas that must be kept free of encroachment in order that the 100-year flood can be carried without substantial increases in flood heights. Minimum standards of the FIA limit such increases in flood heights to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this report are presented to local agencies as minimum standards that can be adopted or that can be used as a basis for additional studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2). As shown on the Flood Boundary and Floodway Map (Exhibit 3), the floodway boundaries were determined at cross sections; between cross sections the boundaries were interpolated. In cases where the boundaries of the floodway and the 100-year flood are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and the boundary of the 100-year flood is termed the floodway fringe. The floodway fringe thus encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain development are shown in Figure 2.

For floodway determinations, starting water-surface elevations at or near confluences with larger stream systems were not based on backwater effects from the larger system. Therefore, floodway surcharge elevations shown in Table 2 for these downstream sections are <u>below</u> rather than <u>above</u> the 100-year flood elevations as shown on the Flood Profiles (Exhibit 1).

5.0 INSURANCE APPLICATION

In order to establish actuarial insurance rates, the FIA has developed a process to transform the data from the engineering study into flood

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Fishing Creek							
VM	8,182	2,631	20,340	2.9	477.9	476.9[3]	1.0
VN	9,465	1,821	12,804	4.6	478.8	477.9	0.9
VO	11,075	470	4,840	12.1	481.6	480.8	0.8
VP	11,600	367	5,762	10.2	484.1	483.3	0.8
VQ	12,130	276	5,636	10.4	485.9	485.4	0.5
VR	12,500	224	4,401	13.3	485.9	485.4	0.5
VS	13,250	525	8,097	7.2	488.9	488.7	0.2
VT	13,700	495	7,784	7.5	489.4	488.9	0.5
VU	14,240	340	6,334	9.2	490.0	489.8	0.2
VV	15,180	320	5,918	9.9	491.2	490.4	0.8
VW	15,970	725	12,093	4.8	493.4	492.4	1.0
VX	16,380	799	12,290	4.8	493.8	492.9	0.9
VY	16,955	1,014	14,200	4.1	494.1	493.2	0.9
VZ	17,585	780	9,917	5.9	494.3	493.3	1.0
WA	17,965	966	13,079	4.5	495.1	494.2	0.9
WB	18,445	831	10,532	5.6	495.3	494.5	0.8
WC	19,165	1,113	12,453	4.7	496.2	495.4	0.8

[1] Feet above confluence with Susquehanna River
[2] This width extends beyond corporate limits
[3] Elevations computed without considering backwater effects from Susquehanna River

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOODWAY DATA

FISHING CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE	WIDTH[3] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Fishing Creek (continued)							
WD	19,905[1]	350	5,717	10.2	496.9	496.0	0.9
Hemlock Creek							
ABA	390[2]	429	2,473	3.4	474.5	473.5[4]	1.0
ABB	640[2]	305	985	8.6	475.8	475.5[4]	0.3
ABC	1,170[2]	215	1,333	6.4	481.2	480.4	0.8
ABD	1,405[2]	189	1,112	7.6	482.7	481.8	0.9
ABE	1,765[2]	280	1,608	5.3	485.4	484.4	1.0
ABF	2,185[2]	154	919	9.3	487.5	486.8	0.7
ABG	2,405[2]	112	1,233	6.9	494.4	494.4	0.0
ABH	2,780[2]	142	1,511	5.6	495.6	495.2	0.4
ABI	3,140[2]	227	1,990	4.3	496.6	495.7	0.9
ABJ	3,455[2]	259	1,813	4.7	497.2	496.3	0.9
ABK	3,915[2]	190	1,002	8.5	498.6	498.6	0.0
ABL	4,125[2]	160	890	9.6	499.4	499.3	0.1
ABM	4,425[2]	107	797	10.7	502.6	502.3	0.3

[1] Feet above confluence with Susquehanna River

[2] Feet above confluence with Fishing Creek

[3] This width extends beyond corporate limits

[4] Elevations computed without considering backwater effects from Susquehanna River

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOODWAY DATA

FISHING CREEK AND HEMLOCK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Hemlock Creek (continued)							
ABN	4,750	125	723	11.8	506.0	506.0	0.0
ABO	5,050	158	1,318	6.5	509.9	509.0	0.9
ABP	5,420	76	758	11.2	511.0	510.0	1.0
ABQ	5,745	71	761	11.2	513.8	512.9	0.9
ABR	6,130	87	844	10.1	516.9	516.2	0.7
ABS	6,395	107	1,053	8.1	518.7	517.8	0.9
ABT	6,635	93	932	9.1	519.5	518.6	0.9
ABU	6,885	142	1,137	7.5	521.1	520.2	0.9
ABV	7,145	155	1,220	7.0	522.3	521.4	0.9
ABW	7,390	153	1,063	8.0	523.2	522.4	0.8
ABX	7,635	132	941	9.1	524.6	523.9	0.7
ABY	8,125	258	2,099	4.1	528.5	527.5	1.0
ABZ	8,475	363	2,750	3.1	529.3	528.3	1.0
ACA	8,690	397	2,230	3.8	529.6	528.6	1.0
ACB	9,040	206	1,030	8.3	530.2	529.3	0.9
ACC	9,300	252	1,381	6.2	532.5	531.6	0.9
ACD	9,605	257	1,257	6.8	533.6	533.3	0.3

[1] Feet above confluence with Fishing Creek

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOODWAY DATA

HEMLOCK CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Hemlock Creek (continued)							
ACE	9,865	298	1,691	5.0	535.5	534.6	0.9
ACF	10,065	304	1,506	5.6	536.5	535.7	0.8
ACG	10,455	359	1,886	4.5	538.3	537.9	0.4
ACH	10,680	229	1,036	8.2	538.9	538.6	0.3
ACI	11,015	181	1,829	4.7	543.9	543.5	0.4
ACJ	11,215	227	2,032	4.2	544.3	543.5	0.8
ACK	11,655	252	879	9.7	545.1	544.9	0.2
ACL	11,985	452	2,470	3.4	548.8	547.8	1.0
Little Fishing Creek							
WG	570	399[2]	6,802	2.9	500.7	500.0	0.7
WH	965	654[2]	9,828	2.0	500.8	500.1	0.7
WI	2,315	700[2]	10,840	1.8	500.9	500.2	0.7
ADA	2,645	820[2]	9,158	2.2	501.0	500.3	0.7
ADB	3,100	919[2]	7,633	2.6	501.0	500.3	0.7
ADC	3,655	1,070[2]	7,806	2.5	501.2	500.4	0.8
ADD	4,160	562[2]	4,314	4.6	501.6	501.0	0.6

[1] Feet above confluence with Fishing Creek
[2] This width extends beyond corporate limits

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOODWAY DATA

HEMLOCK CREEK AND LITTLE FISHING CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Little Fishing Creek (continued)							
ADE	4,790	456	3,040	6.5	502.4	501.6	0.8
ADF	5,255	358	2,365	8.4	503.5	502.9	0.6
ADG	5,540	275	2,170	9.2	505.0	504.4	0.6
ADH	5,875	312	2,803	7.1	507.2	506.3	0.9
ADI	6,405	347	3,266	6.1	508.8	507.9	0.9
ADJ	6,905	262	2,407	8.3	509.9	509.0	0.9
ADK	7,535	261	2,096	9.5	511.9	511.1	0.8
ADL	8,120	460	3,651	5.5	514.9	514.0	0.9
ADM	8,710	440	3,212	6.2	516.3	515.4	0.9
ADN	9,030	525	4,361	4.6	519.9	519.2	0.7
ADO	9,365	429	4,195	4.7	520.5	519.7	0.8
ADP	9,990	609	5,155	3.9	521.3	520.5	0.8
ADQ	10,650	522	3,667	5.4	522.1	521.3	0.8
ADR	11,125	461	3,144	6.3	523.2	522.3	0.9
ADS	11,820	203	1,766	11.3	525.2	524.3	0.9
ADT	12,205	183	1,932	10.3	527.5	526.9	0.6

[1]Feet above confluence with Fishing Creek
[2]This width extends beyond corporate limits

TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOODWAY DATA

LITTLE FISHING CREEK

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION		
CROSS SECTION	DISTANCE[1]	WIDTH[2] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	WITH FLOODWAY (NGVD)	WITHOUT FLOODWAY (NGVD)	DIFFERENCE (FT.)
Little Fishing Creek (continued)							
ADU	12,710	184	2,021	9.8	529.9	529.2	0.7
ADV	13,375	236	2,286	8.7	532.5	531.6	0.9
ADW	13,910	199	2,147	9.3	534.2	533.2	1.0
ADX	14,530	238	2,590	7.7	536.4	535.6	0.8
ADY	14,700	228	2,937	6.8	537.0	536.4	0.6
ADZ	15,185	242	2,757	7.2	537.8	537.1	0.7
AEA	15,675	174	1,876	10.6	538.5	538.1	0.4
AEB	16,185	215	2,277	8.7	541.0	540.1	0.9
AEC	16,965	238	2,817	7.1	543.6	542.7	0.9
AED	17,460	161	1,723	11.5	544.5	543.7	0.8
AEE	17,595	191	2,634	7.6	549.2	549.1	0.1
AEF	18,190	221	2,481	8.0	550.0	549.7	0.3
AEG	18,700	289	3,209	6.2	551.8	551.1	0.7
AEH	19,200	268	3,187	6.2	552.5	551.8	0.7

[1] Feet above confluence with Fishing Creek
[2] This width extends beyond corporate limits

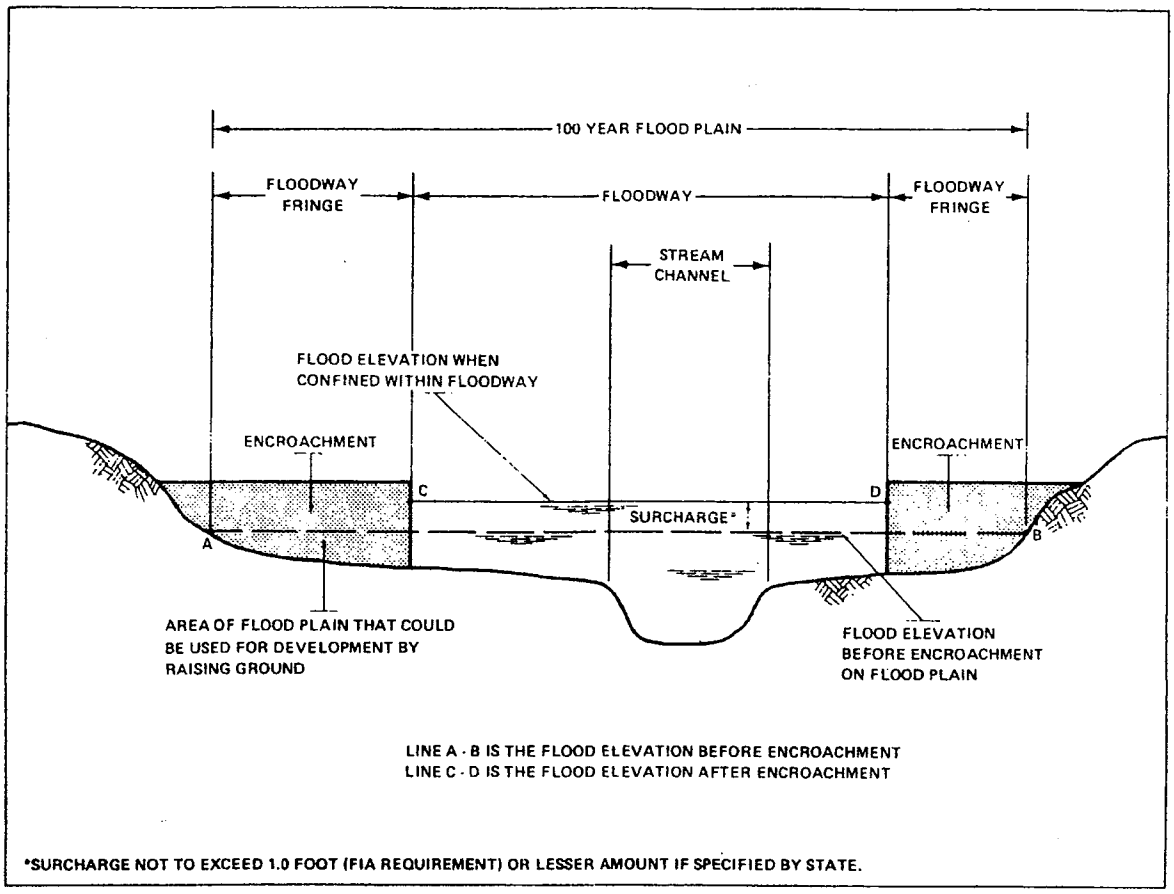
TABLE 2

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOODWAY DATA

LITTLE FISHING CREEK



FLOODWAY SCHEMATIC Figure 2

insurance criteria. This process includes the determination of reaches, Flood Hazard Factors (FHFs), and flood insurance zone designations for each flooding source affecting the Township of Hemlock.

5.1 Reach Determinations

Reaches are defined as lengths of watercourses having relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference does not have a variation greater than that indicated in the following table for more than 20 percent of the reach.

Average Difference Between 10- and 100-year Floods	Variation
2 to 7 feet	1.0 foot

The location of reaches determined for the flooding sources of the Township of Hemlock are shown on the Flood Profiles (Exhibit 1) and are summarized in the Flood Insurance Zone Data Table (Table 3).

5.2 Flood Hazard Factors

The FHF is the FIA device used to correlate flood information with insurance rate tables. Correlations between property damage from floods and their FHFs are used to set actuarial insurance premium rate tables based on FHFs from 005 to 200.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations expressed to the nearest 0.5 foot, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year water-surface elevations is greater than 10.0 feet, accuracy for the FHF is to the nearest foot.

5.3 Flood Insurance Zones

After the determination of reaches and their respective FHFs, the entire incorporated area of the Township of Hemlock was divided into zones, each having a specific flood potential or hazard. Each zone was assigned one of the following flood insurance zone designations:

Zone A:	Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods, no base flood elevations shown or FHFs determined.
Zones A5, A6, A7, A8, A9, A10, A12, A13, A14:	Special Flood Hazard Areas inundated by the 100-year flood, determined by detailed methods; base flood elevations shown and zones assigned according to the FHFs.

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Susquehanna River Backwater area affecting Fishing Creek and Hemlock Creek	15	-6.7	-1.8	+5.1	065	A13	Varies
Fishing Creek							
Reach 1	15	-3.0	-1.5	+4.9	030	A6	Varies
Reach 2	15	-7.0	-2.3	+5.5	070	A14	Varies
Reach 3	15	-6.4	-2.3	+6.7	065	A13	Varies
Hemlock Creek							
Reach 1	15	-2.9	-0.9	+3.3	030	A6	Varies
Reach 2	15	-4.0	-1.3	+3.5	040	A8	Varies
Reach 3	15	-2.7	-0.9	+2.5	025	A5	Varies
Reach 4	15	-4.8	-2.1	+4.8	050	A10	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOOD INSURANCE ZONE DATA

SUSQUEHANNA RIVER, FISHING CREEK, AND HEMLOCK CREEK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Little Fishing Creek							
Reach 1	15	-3.4	-1.1	+3.8	035	A7	Varies
Reach 2	05	-4.5	-1.6	+4.6	045	A9	Varies
Reach 3	05	-6.1	-2.1	+5.4	060	A12	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

TABLE 3

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOOD INSURANCE ZONE DATA

LITTLE FISHING CREEK

Zone B: Areas between the Special Flood Hazard Area and the limits of the 500-year flood; including areas of the 500-year flood plain that are protected from the 100-year flood by dike, levee, or other water control structure; also areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided.

Zone C: Areas of minimal flooding.

Table 3, "Flood Insurance Zone Data," summarizes the flood elevation differences, FHFs, flood insurance zones, and base flood elevations for each flooding source studied in detail in the Township of Hemlock.

5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the Township of Hemlock is, for insurance purposes, the principal result of the Flood Insurance Study. This map (published separately) contains the official delineation of flood insurance zones and base flood elevation lines. Base flood elevation lines show the locations of the expected whole-foot water-surface elevations of the base (100-year) flood. This map is developed in accordance with the latest flood insurance map preparation guidelines published by the FIA.

6.0 OTHER STUDIES

Flood Insurance Studies for the contiguous communities of the Township of Mount Pleasant (Reference 7), the Town of Bloomsburg (Reference 8), and the Township of Montour (Reference 9) were prepared concurrently with this study. Data presented in these studies are in exact agreement with the data presented for the Township of Hemlock.

This study is authoritative for purposes of the Flood Insurance Program and the data presented here either supersede or are compatible with previous determinations.

7.0 LOCATION OF DATA

Survey, hydrologic, hydraulic, and other pertinent data used in this study can be obtained by contacting the office of the Federal Insurance Administration, Region III Office, Curtis Building, Sixth and Walnut Streets, Philadelphia, Pennsylvania 19106.

8.0 BIBLIOGRAPHY AND REFERENCES

1. U. S. Department of the Interior, Geological Survey, 1975 Water Resources Data for Pennsylvania, Surface Water Records, Harrisburg, Pennsylvania, 1975.

2. U. S. Army Corps of Engineers, Hydrologic Study Tropical Storm Agnes, New York City, New York, December 1975.

3. Water Resources Council, "A Uniform Technique for Determining Flood Flow Frequencies," Bulletin 15, Washington, D. C., December 1967.

4. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

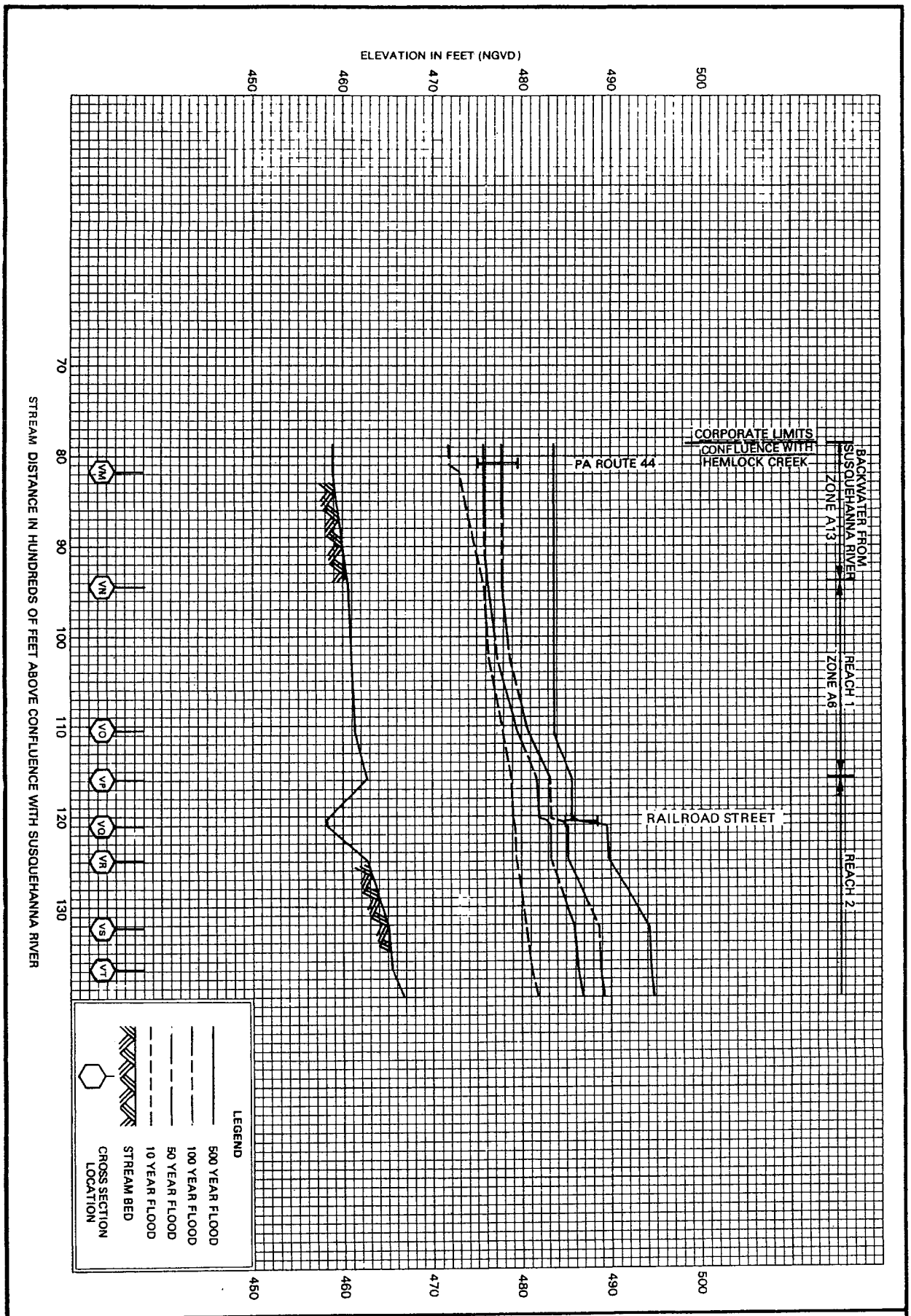
5. Michael Baker, Jr., Inc., Topographic Maps compiled from aerial photographs, Scale 1:2,400, Contour Interval 5 feet: Susquehanna River, Columbia County, Pennsylvania, April 1975.

6. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

7. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of Mount Pleasant, Columbia County, Pennsylvania, Washington, D. C., unpublished.

8. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Town of Bloomsburg, Columbia County, Pennsylvania, Washington, D. C., unpublished.

9. U. S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Insurance Study, Township of Montour, Columbia County, Pennsylvania, Washington, D. C., unpublished.



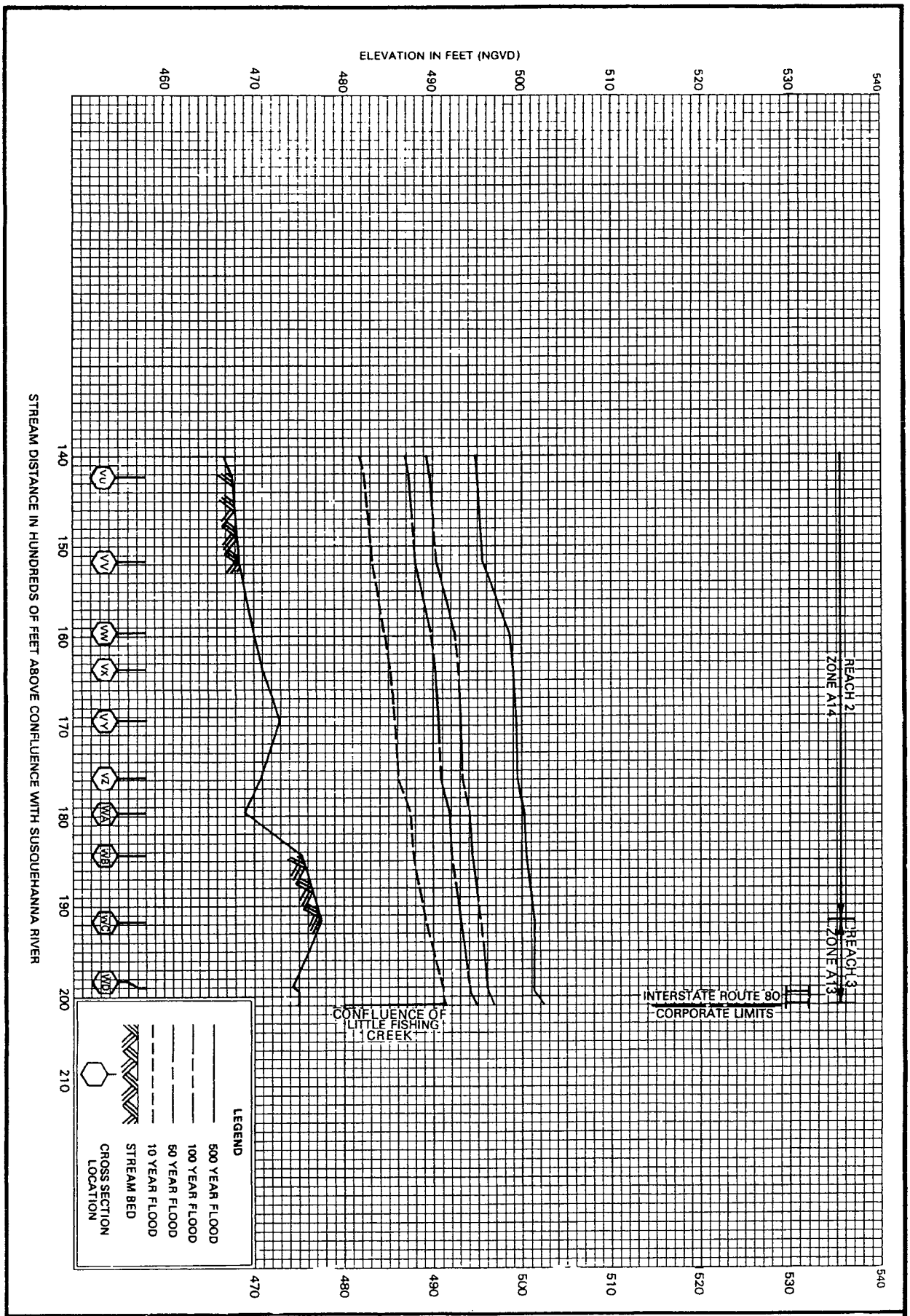
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOOD PROFILES

FISHING CREEK

01P



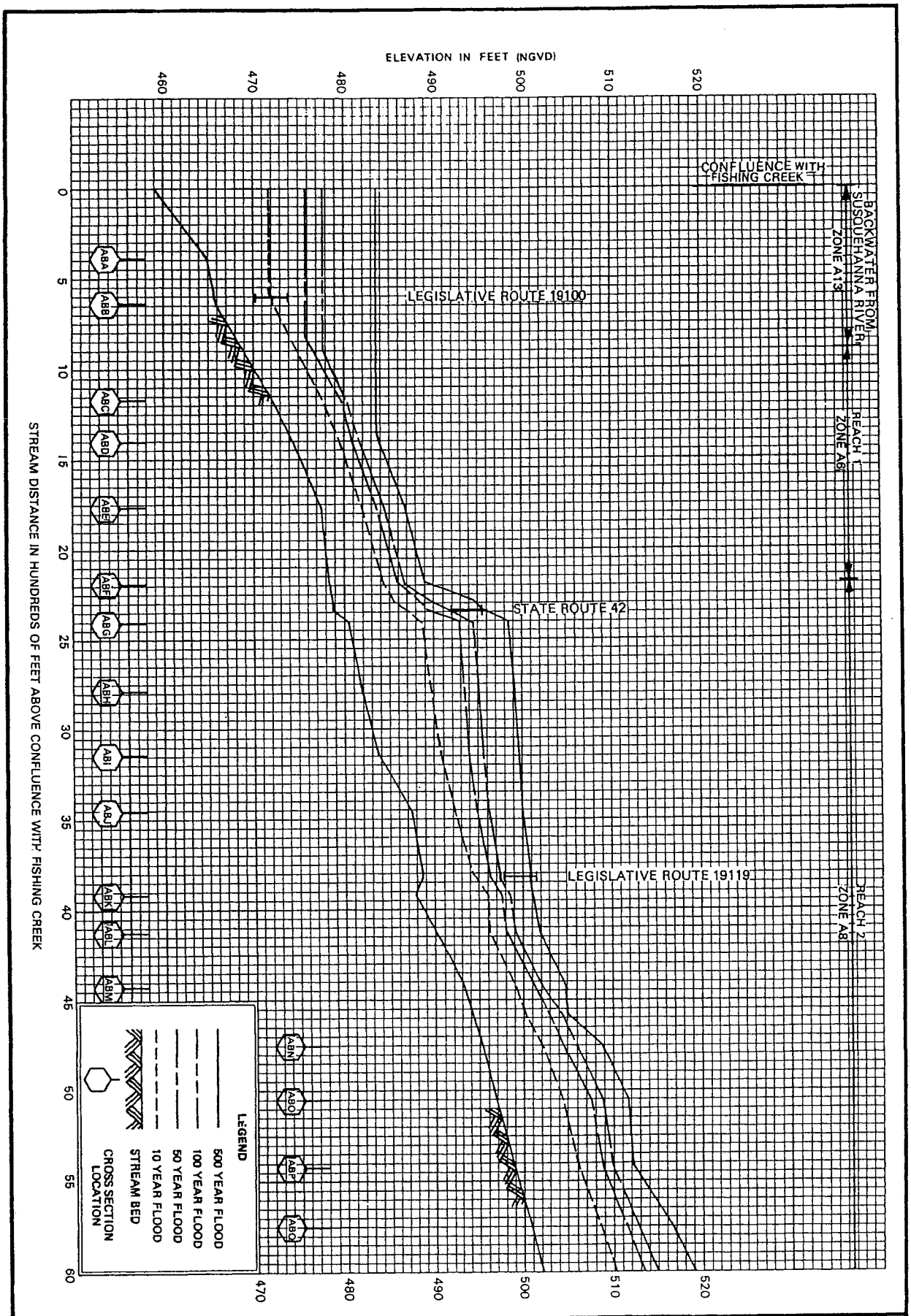
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

02P

FLOOD PROFILES

FISHING CREEK



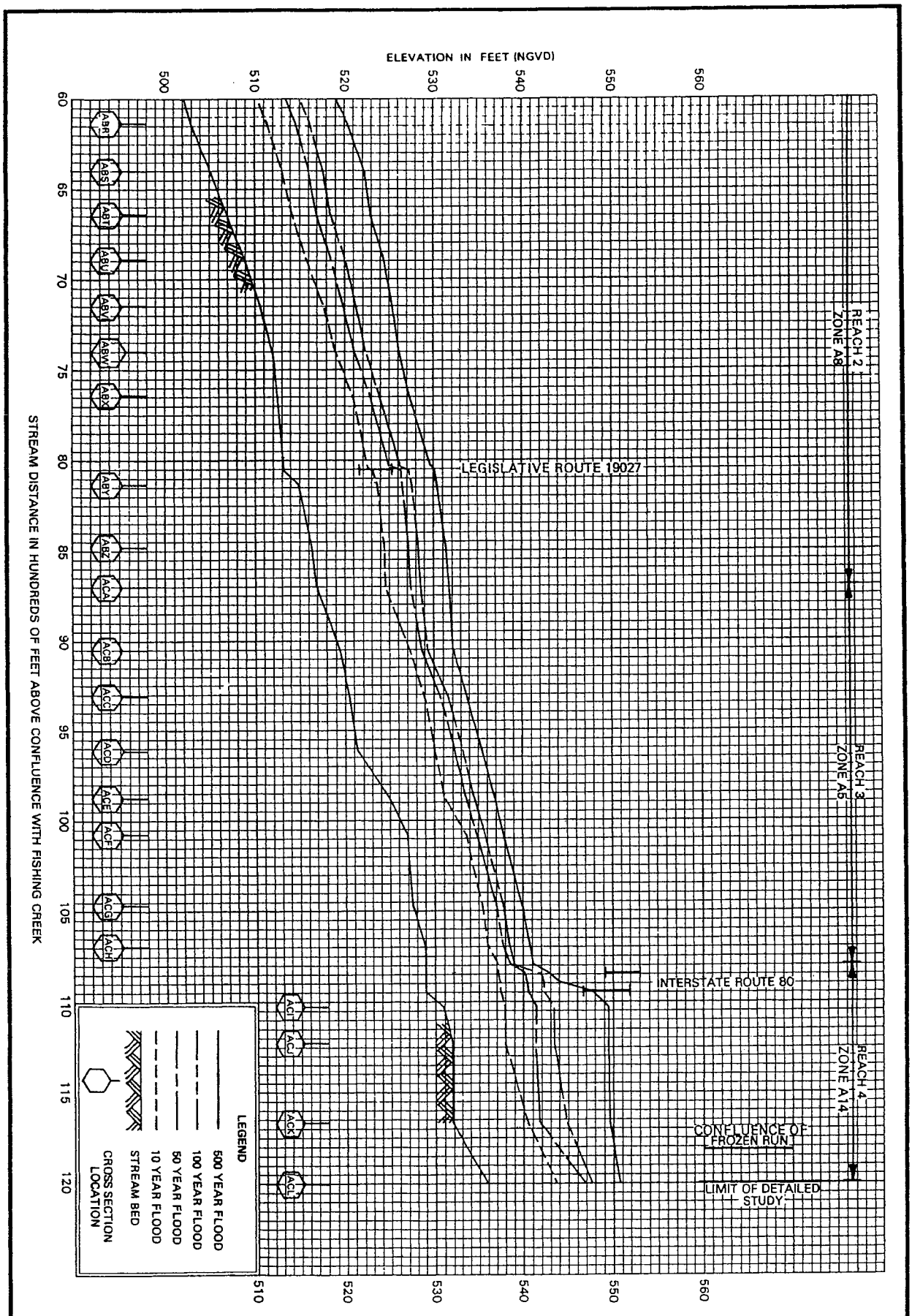
03P

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOOD PROFILES

HEMLOCK CREEK



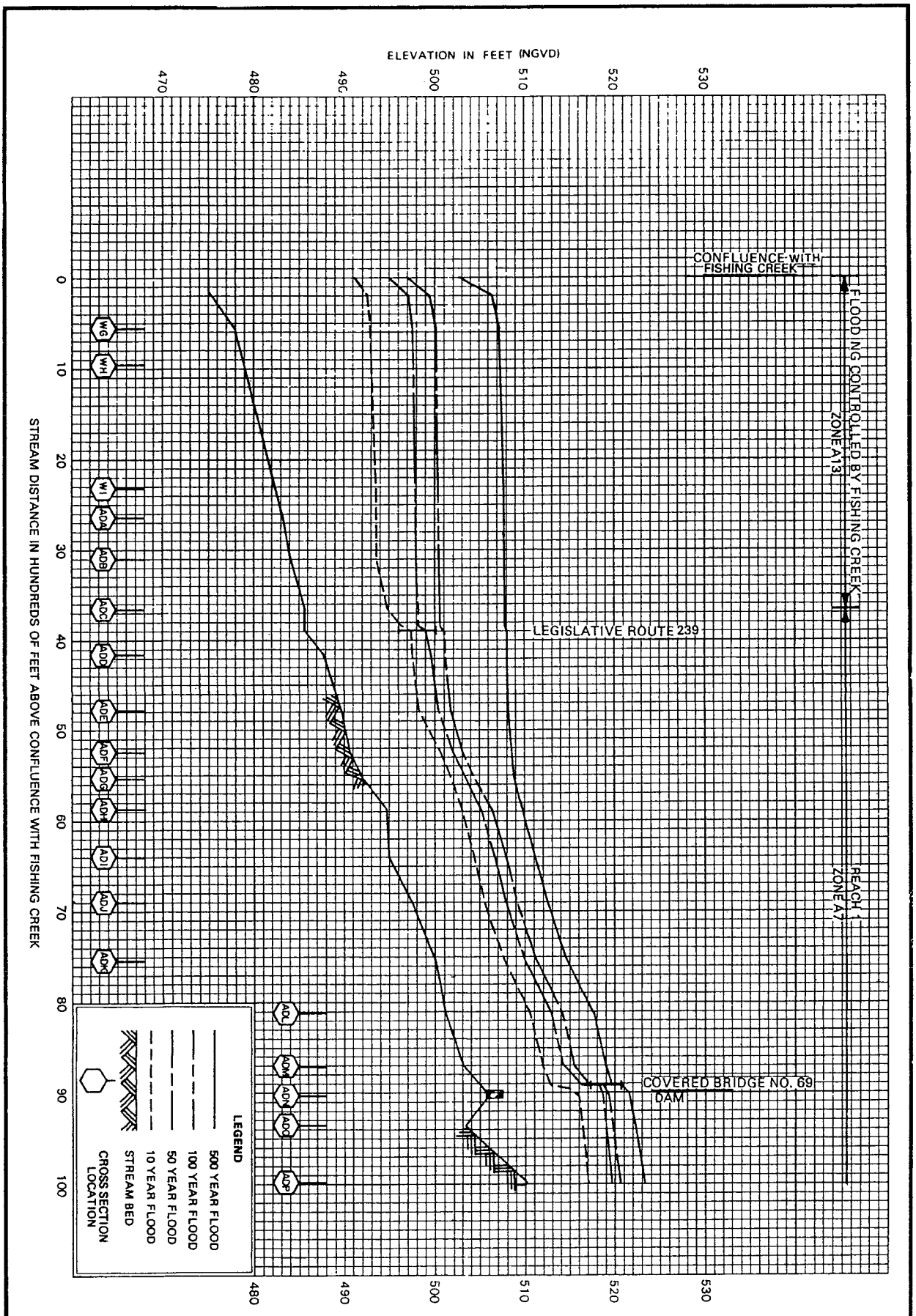
04P

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

FLOOD PROFILES

HEMLOCK CREEK



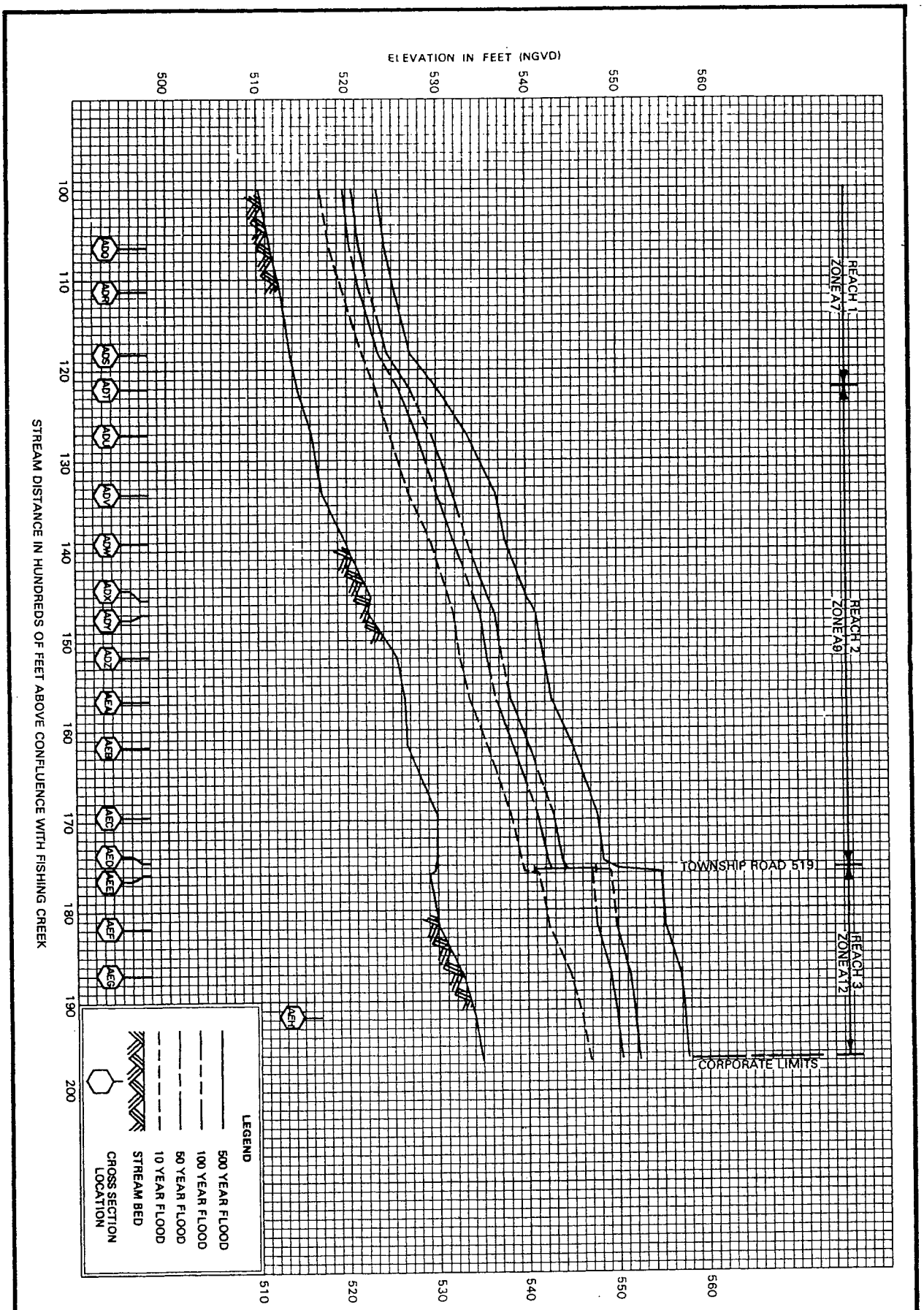
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA
(COLUMBIA CO.)

05P

FLOOD PROFILES

LITTLE FISHING CREEK



DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT
Federal Insurance Administration

TOWNSHIP OF HEMLOCK, PA

(COLUMBIA CO.)

FLOOD PROFILES

LITTLE FISHING CREEK

06P